# THE THz/FIR SPECTRUM OF SMALL WATER CLUSTERS IN HELIUM NANODROPLETS

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The microscopic properties of water that are relevant for bulk solvation processes are still not fully understood. Here, we combine mass selective Helium nanodroplet spectroscopy with the powerful Terahertz (THz) and far-infrared (FIR) capabilities of the free electron laser facility FELIX to study the fingerprint of small neutral water clusters in the wavelength range from 90-900$\mathrm{cm}^{-1}$. Helium nanodroplets are a gentle, superfluid matrix and allow aggregation of pre-cooled moieties at ultra-cold temperatures (0.37 K). The fast cooling rate allows in some cases to stabilize not only the global minimum structure but also local minimum structures. The FELIX facility in Nijmegen provides narrowband ($\Delta\nu/\nu = 0.5\%$) pulsed radation covering the frequency range from 80–3300 $\mathrm{cm}^{-1}$. We used a repetition rate of 10 Hz and typical pulse energies from 10 mJ at the 90$\mathrm{cm}^{-1}$and 40 mJ at 900$\mathrm{cm}^{-1}$. This corresponds to average powers of 100–400 mW far beyond those available using other radiation sources in this frequency range. The observed spectrum is exceptionally rich and includes lines that are close to or below our resolution limit. By mass selective detection and by varying the pickup pressure, we were able to identify contributions from dimer, trimer, tetramer and pentamer. The number of resonances indicates stabilization of at least two trimer structures in He nanodroplets. A comparison with theoretical predictions is on the way. We are confident that our experiments will contribute to understand the very special behavior of water in a bottom up approach.

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